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MEADOW VALLEY MOUNTAINS G-E-M

RESOURCES AREA

(GRA NO. NV-26)

TECHNICAL REPORT

(WSAs NV 050-0156)

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Final Report

April 29, 1983

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EXECUTIVE SUMMARY

The Meadow Valley Mountains Geology-Energy-Minerals (GEM) Resource Area (GRA) includes the following Wilderness Study Area (WSA): NV 050-0156. The GRA is located in south-central Lincoln County, Nevada just east of U. S. Highway 93.

The WSA comprises most of the Meadow Valley Mountains which consists primarily of 200-600 million year old sediments in its southern part and less than 60 million year old volcanic rocks overlying the sediments in its northern part. The Meadow Valley Mountains are typical of the Basin and Range structure.

There are no known metallic mineral resources in the WSA, but there are two claim groups described below which are believed to be staked for precious metals. The two reported nonmetallic mineral resource deposits in the WSA are a perlite deposit in the north and a gypsum deposit in the east. Other nonmetallic occurrences include abundant carbonate rocks throughout the southern portion of the range.

There are no patented claims in the WSA nor are there any mining districts in the WSA. Unpatented claims in the WSA are found at two locations. One is a large lode claim group consisting of approximately 100 claims, less than half of which overlap into the WSA, located on the west flank of the range adjacent to Kane Springs Wash; and the second is approximately 20 placer claims in the very southeast corner of the WSA, which is part of a much larger group of claims in the alluvial fans surrounding the southern flanks of the Mormon Mountains to the east. There are oil and gas leases covering all of the GRA, but no geothermal leases.

Most of the WSA has a low potential for metallic mineral resources, with a very low confidence level. Where the older sediments are exposed the metallic mineral favorability is very low with a low confidence level. For nonmetallic mineral resources most of the WSA underlain by volcanic rocks is classified as having a low favorability with a low confidence level while that part of the WSA underlain by the older sediments is classified as having a moderate favorability with a moderate confidence level. Two areas covering the above mentioned perlite and gypsum deposits are classified as having a high favorability with a moderate confidence level. Uranium has a low favorability with a low confidence level throughout the WSA, and thorium has very low favorability with a very low confidence level. Oil and gas has a moderate favorability on the east side of the WSA and a low favorability on the west, both with a very low confidence level however. Geothermal resources have a low favorability with a very low confidence level.

Additional geological information is needed to more thoroughly evaluate mineral potential. The claims in the WSA and the reported perlite and gypsum deposits need further verification.

I. INTRODUCTION

The Meadow Valley Mountains G-E-M Resources Area (GRA No. NV-26) contains approximately 360,000 acres (1,500 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
Meadow Valley Mountains	NV 050-0156

The GRA is located in Nevada within the Bureau of Land Management's (BLM) Caliente Resource Area, Las Vegas district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 37°00' north latitude, 114°45' west longitude and includes the following townships:

T 8 S, R 65,66 E	T 11 S, R 63-66 E
T 9 S, R 65-67 E	T 12 S, R 63-66 E
T 10 S, R 64-67 E	T 13 S, R 63-66 E

The areas of the WSA are on the following U. S. Geological Survey topographic maps:

7.5-minute:

Elgin	Vigo, NW
Vigo, NE	Lyman Crossing
Delamar 3, SE	Sunflower Mountain
Vigo	Wildcat Wash, NW
Wildcat Wash, NE	Wildcat Wash, SE
Rox	Farrier

The nearest town is Moapa which is located a few miles south of the southern boundary of the GRA. Access to the area is via U. S. Highway 93 to the west and State Route 7 to the south. Access within the area is along the Kane Springs Wash road, the Meadow Valley Wash road and unimproved dirt roads peripheral to the included WSA.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the corresponding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range Province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

Some of the claims in this WSA were field checked in December of 1982.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included with the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposits, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most important aspects of geological environments that were in the minds of the authors when they wrote these reports.

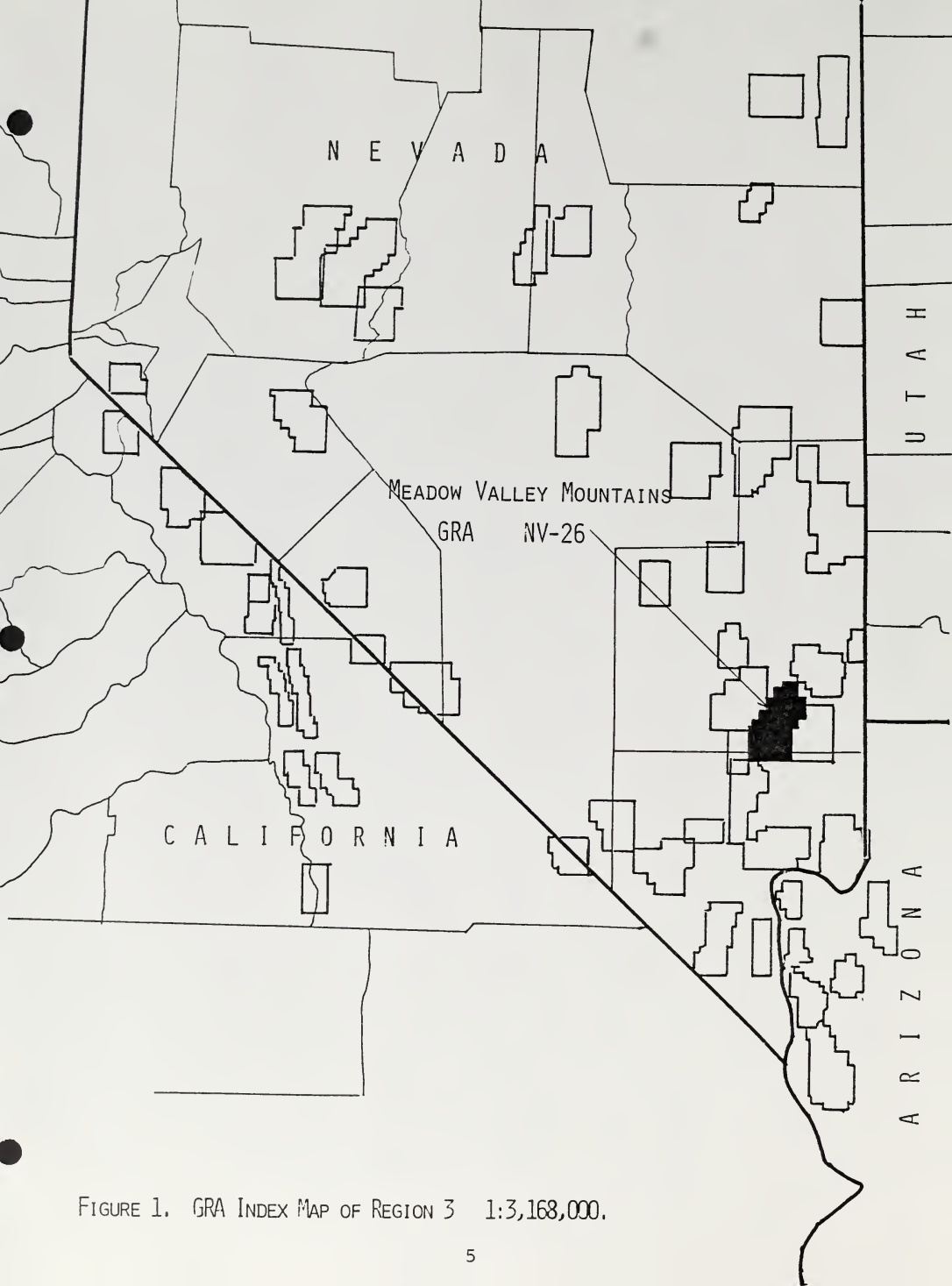
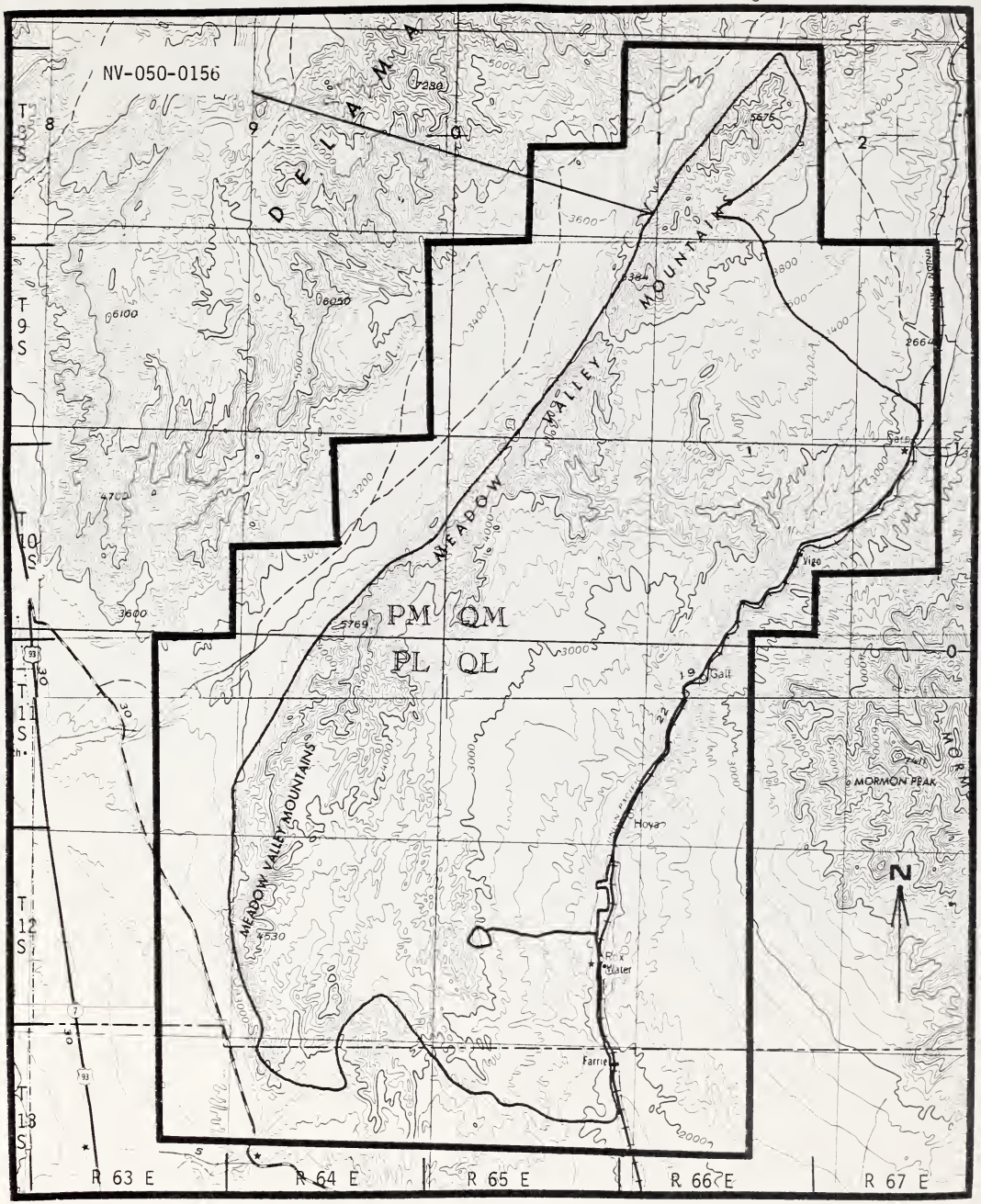


FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.

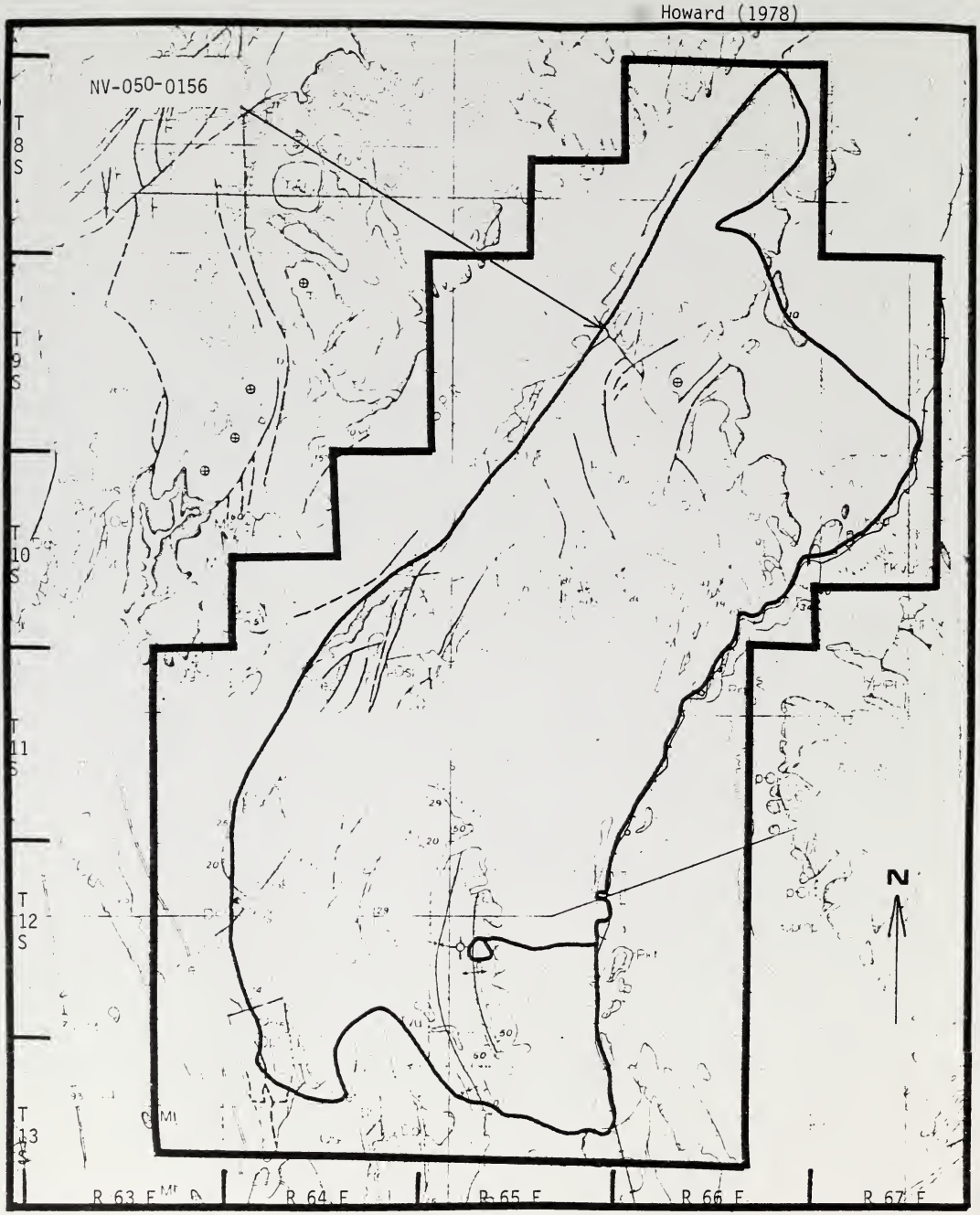


Topographic Map
1:250,000

Meadow Valley Mountains GRA NV-26

GRA Boundary
WSA Boundary

Figure 2



Geologic Map
1:250,000

Meadow Valley Mountains GRA NV-26

Figure 3

See next page for explanation

Cenozoic Sediments

Quaternary, Undifferentiated (Qu): *Includes all sedimentary rocks and surface exposures of recent playa deposits, dune sands, lake beds, shoreline deposits and younger as well as certain older exposures of gravels and other alluvium associated with pediments and mountain streams.*

Tertiary Younger Sediments (Tys): *Sedimentary rocks of Miocene and Pliocene age including oil shale beds of the Muddy Creek Formation and Panaca Formation in Lincoln and Clark Counties, the Muddy Creek Formation in Southwestern Utah; pre-Quaternary sediments in the White River Valley, and sediments associated with ash-flow tuffs near Antelope Summit in White Pine County.*

Tertiary Sediments, Undifferentiated (Tsu): *Primarily Miocene and Oligocene deposits including tuffaceous sediments interbedded with ash-flow tuffs, the Horse Camp Formation and various lacustrine, diatomaceous shales and diatomites in Nye County; intravolcanic and clastic sedimentary rocks in Lincoln and Nye Counties, conglomerates and limestones of uncertain age in the Cortez Mountains and Ranges and the Pocket Mountains of Utah.*

Tertiary Older Sediments (Tos): *Includes the Wheeler Pass Formation of Nye County, the Gilmore Peak Formation in Nye County and western Lincoln County; conglomerates, tuffaceous sandstones and other sedimentary rocks, cherts, claystones, silts, carbonaceous shales and oil shales in Nye County; and older limestones of the Illipah area and the Kawich Canyon Formation of the Schell Creek and Grant Ranges in White Pine County.*

Volcanics

Basalt (Qtb): *Basalt flows, cinders and tuffs of Quaternary or Tertiary age in Nye County.*

Basalt (Tb): *Intermediate and basaltic lavas including the Trachyte Basalt Member of the Muddy Creek Formation in Clark County, basalt flows, basaltic cinder, tuff and lava cones which are younger than the Panbury Formation and latite flows in White Pine County; andesite and basalt flows in Lincoln County andesite and basalt flows in North Central Nevada and basalt and basaltic andesite flows in Southwestern Utah.*

Tertiary Volcanics, Undifferentiated (Tv): *Includes rocks ranging from early to late Tertiary volcanic rocks ranging in composition from silicic to intermediate; primarily rhyolites, dacites, quartz latite flows, ignimbrites and pyroclastics of widespread occurrence. These rocks are listed under various subdivisions in Elko, Lincoln, and Nye Counties, North Central Nevada and Southwestern Utah.*

Tertiary Older Volcanics (Tov): *Pre-Miocene volcanic rocks lithologically similar to Tertiary Volcanics, Undifferentiated (Tvu). Listed under various subdivisions in Nye County.*

Intrusives (Ti): *Occurred from mid-Jurassic through late Tertiary. Widespread intrusions ranging in composition from granitic through dioritic to gabbroic and texture from holocrystalline to porphyritic.*

Mesozoic Sediments

Tertiary Cretaceous Sediments (TKsu): *Continental sediments consisting of conglomerates, clastics, tuffs and limestones. Includes the Gale Hills Formation and the Overton Fanglomerate.*

Cretaceous Sediments (Ks): *Chiefly non-marine siltstone, shale, conglomerate and limestone. Includes lower Gale Hills Formation, Thumb Formation, Baseline Sandstone, Willow Tank and Newark Canyon Formations.*

Jurassic (Ju): *Eolian cross-bedded sandstone in Utah, volcanically derived sediments, ash flows and basic lava flows in northern Elko County. Includes Navajo Sandstone, Aztec Sandstone, Frenchie Creek Formation and Bayer Ranch Formation.*

Jurassic-Triassic (JTu): *Includes Nugget and Aztec Sandstones and Chinle Formation of southern Nevada.*

Triassic (Tu): *Shallow marine sedimentary rocks including Chinle, Shinarump, Thaynes and Moenkopi Formations in the west and continental to shallow marine sediments in the east.*

Mesozoic Volcanics

Tertiary-Cretaceous Volcanics (TKv): *Occur in Lincoln County where they cover wide areas of the Clover, Del Mar, Wilson Creek, White Rock and Mahogany Mountains.*

Paleozoic Sediments

Permian, Undifferentiated (Pu): *Shallow marine intertidal and continental sediments. Includes Gerster Formation, Plympton Formation, Kaibab Limestone, Pequop Formation, Coconino Sandstone, Toroweap Formation, Rieptown Formation, Rib Hill Sandstone, Pierpe Springs Formation, Carbon Ridge Formation and Loray Limestone. With the exception of parts of White Pine County, local symbols are used to identify all Permian outcrops. In White Pine County, local symbols are used except for the Park City Group which is grouped with the Arcturus and Rib Hill Sandstones (Par). To avoid confusion, the standard symbol used for Permian in Utah has been replaced with the standard "P".*

Pennsylvanian-Permian (PPu): *Massive sandstone, limestone and dolomite (dolomitized in places). Includes Rib Hill Sandstone, Ely Limestone, Ferguson Mountain Formation in southeastern White Pine County, Nealon Formation, Bird Spring Mountain Formation, Bacon Flat Formation and Carlin Canyon Formation in Eureka County, Pablo Formation in Nye County and Oquirrh Formation or group in Utah. Local symbols are used where possible.*

Pennsylvanian, Undifferentiated (Pu): *Includes Ely Limestone, Moleen and Tomera Formations. To avoid confusion, the non-standard symbol used for Pennsylvanian in Utah has been replaced by "P".*

Mississippian Upper (Mu): *Includes Diamond Peak and Bird Spring Formations, Callville Limestone, Scotty Peak Formation, Ochre Mountain Limestone and Monte Cristo Limestone in parts of Clark County. Chainman Shale combined with Diamond Peak Formation in some parts of Utah.*

Mississippian, Chainman Shale (Mc): *Includes Mountain City Formation in Elko County and Ikeana Formation in Nye Co.*

Mississippian, Lower (Ml): *Includes Monte Cristo and Rogers Spring Limestones in Clark County; Joana, Mercury and Bristol Pass Limestones in Lincoln County; and Joana Limestone elsewhere.*

Mississippian-Devonian, Undfiferentiated (MDu) *Includes Rogers Spring Limestone and Muddy Peak Limestone in parts of Clark County; Joana Limestone and Pilot Shale in Elko County, Pilot Shale, Joana Limestone, Chainman Shale and Diamond Peak Formation in Eureka and White Pine Counties.*

Mississippian-Devonian, Pilot Shale (MDp): *Shown in combination with other Mississippian Formations in Clark, Elko, parts of Lincoln, Eureka and White Pine Counties.*

Devonian-Cambrian, Undifferentiated (DSO€u): *Undivided limestone and dolomite occurring in Lincoln County.*

Devonian-Ordovician, Undifferentiated (DSOu) *Dolomites in Elko and Nye Counties*

Devonian, Upper (Du): *Primarily Devils Gate and Guilmette Formations. Also includes Sevy and Simonson dolomites in parts of White Pine County. Contains Guilmette, Devils Gate, Simonson and Sevy in Elko County under the heading of* Dgd. *Local symbols used where possible*

Simonson Dolomite (Dsi): *Alternating light to dark gray fine to coarse grained dolomite. Included with other Silurian and Devonian sediments in North Central Nevada and parts of Utah. Grouped with Sevy Dolomite in parts of Clark, Elko, Eureka, Nye, and White Pine Counties.*

Sevy Dolomite (Dsv): *Very light colored, dense, distinctly bedded unfossiliferous dolomite. Combined with other Devonian and Silurian sediments in parts of North Central Nevada and Utah and with the Simonson Dolomite in parts of Clark, Elko, Eureka, Nye and White Pine Counties.*

Sevy and Simonson Dolomites, combined (Dsv): *Also includes the Sultan and Muddy Peak Limestones in Clark County; Nevada Formation in Elko County; Devils Gate Formation in Eureka County; Nevada Formation, Woodpecker Limestone, Oxyoke Canyon Sandstone and Rabbit Hill Formation in Nye County; Nevada Formation and Devils Gate Formation in Eureka County and the Nevada Formation in White Pine County. Local symbols are used where possible.*

Devonian, Western Facies (Dw): *A portion of the western allochthonous assemblage. Includes Woodruff Formation and Slavern Chert in Eureka County and silicious siltstone in the Cockalorum Wash area of Nye County.*

Silurian, Undifferentiated (Su): *Includes Lone Mountain and Laketown Dolomites throughout the mapping area, the Elder Sandstone and Fish Haven Dolomite formation in Eureka County, and the Roberts Mountain formation in Nye County. In White Pine County, the Silurian deposits are grouped with the upper Ordovician sediments under the heading of Upper Ordovician, Undifferentiated (SOu).*

Upper Ordovician, Undifferentiated (Ouou): *Includes Ely Springs and Fish Haven Dolomites and the Hanson Creek Formation. Local symbols are used where possible. Listed as Ordovician, Undifferentiated (Ou) in parts of North Central Nevada. In Clark County, Ely Springs Dolomite has been divided from the rest of* Oep *by the author. The Eureka Quartzite and Pogonip Group are grouped with Silurian sediments under the heading Silurian-Ordovician, Undifferentiated (SOu) in Elko County.*

Ordovician, Eureka Quartzite (Oe): *Light colored vitreous quartzite and hard sandstone. Also includes the Swan Peak Quartzite in parts of Utah. In Clark County, the Eureka Quartzite has been separated from* Oep *by the author. In parts of North Central Nevada, the Eureka Quartzite has been grouped with other Ordovician sediments under the heading of* Ou. *In White Pine County, the Eureka Quartzite has been grouped with the Pogonip Group under the heading of*

Ordovician, Pogonip Group (Op): *Limestone, silty limestone, shale and interformational conglomerates. In Clark County, the Pogonip Group has been separated from* Oep *by the author Includes the Garden City Limestone in parts of Utah. In White Pine County, the Pogonip Group is grouped the Eureka Quartzite under the heading of* Ol.

Ordovician, Undifferentiated (Ou): *Includes the Pogonip Group, Ely Springs Dolomite, Eureka Quartzite and Comus Formation in North Central Nevada*

Ordovician, Vinini Formation (Ov): *Part of the western allochthonous assemblage. Includes Valmi Formation in parts of North Central Nevada. Local symbols are used where possible.*

Cambrian-Ordovician, Undifferentiated (O€u): *Occurs in Elko, Eureka, Nye and White Pine Counties as shale and limestone and is usually so identified when metamorphosed to phyllite. Includes the Tennessee Mountain Formation in Elko County, Board Canyon, Sequence in North Central Nevada, Windfall Formation in Nye County and the lower Ordovician and post-Dunderberg Shale in the Schell Creek Range of White Pine County. In some parts of Nye County,* O€u *is metamorphosed to slate and marble instead of phyllite.*

Cambrian, Upper and Middle (€u): *Primarily limestones, dolomites, shales and quartzites. Includes Edgemont and Peak Limestones in Elko County; Highland Peak formation, Patterson Pass Shale, Pole Canyon Limestone, Chisholm Shale and Lyndon Limestone member of the Chisholm Shale in Lincoln County; Harmony Formation, Preble Formation, Pioche Shale, Eldorado Dolomitee, Geddes Limestone, Secret Canyon, Hamberg, Dole and Dunderberg Shales, Windfall Formation, and Scott Canyon Formation in North Central Nevada; Windfall Formation, Dunderberg Shale, Tybo Shale and Lincoln Park Formation in Nye County; Notch Peak Formation, Dunderberg Shale, Orr Formation, Weeks Formation, Marjum Formation, Wheeler Shale, Swasey Formation, Whirlwind Formation, Dome Limestone, Howell Formation and Tatow Formation in Utah; and Corset Spring Shale, Notch Peak Limestone, Dunderberg Shale and Windfall Limestone in White Pine County. Metamorphosed to schist in Elko County.*

Cambrian, Lower (€pmp): *Primarily Prospect Mountain Dolomite and Pioche Shale. Also includes Tapeats Sandstone, Wood Canyon Formation, Lyndon Limestone, Chisholm Shale and Carrera Formation in Clark County; Sterling Quartzite and Wood Canyon Formation in parts of Lincoln County; Busby Quartzite in the Gold Hill area of Utah and the Stella Lake Quartzite in White Pine County.*

Precambrian

Precambrian Sediments (p€s): *Includes the Johnnie Formation, Stirling Quartzite and some metamorphics in Clark County; Johnnie Formation and lower units of Prospect Mountain Quartzite in Lincoln County; McCoy Creek Group in Elko County; and the McCoy Creek Group excluding the Stella Lake Quartzite in White Pine County*

Precambrian Intrusives (p€i): *Includes the Gold Butte Granite in Clark County and other undifferentiated igneous and metamorphic rocks, primarily granites and pegmatites.*

II. GEOLOGY

The Meadow Valley Mountains GRA lies within the Basin and Range province, and is located in southern Lincoln County with a small portion extending southward into northern Clark County. The WSA 050-0156 study area includes a large portion of the Meadow Valley Mountains which extend 43 miles northeastward from State Route 7, a few miles within Clark County, to Elgin in Meadow Valley Wash.

The northern portion of the GRA is covered predominantly by Tertiary volcanic ignimbrite sequences (see Figure 3). The southern portion includes mostly Paleozoic carbonate marine sediments and Mesozoic clastic rocks.

Northeast-trending Basin and Range normal faults are the most conspicuous structural features in the GRA. The large Kane Springs Wash fault forms the northeast-trending escarpment of the northern part of the Meadow Valley Mountains. Thrusts, cross faults, and minor normal faults subparallel to the major northeast trend are also found within the GRA.

Most of the following description of the geology of the GRA is taken from Tschanz and Pampeyan, 1970.

1. PHYSIOGRAPHY

The Meadow Valley Mountains GRA lies in the Basin and Range province and is located in southern Lincoln County with a small portion extending southward into northern Clark County. The study area includes a large portion of the Meadow Valley Mountains which extend 43 miles northeastward from State Highway 7 a few miles within Clark County to Elgin in Meadow Valley Wash.

Every geologic period except the Precambrian, Jurassic and Cretaceous are represented by the rocks found in the range. The thick sequence of Paleozoic rocks generally represent a transition zone between the shelf facies in the Mormon Mountains to the east and the miogeosynclinal facies of the remainder of Lincoln County.

The west edge of the range is bounded by a steep scarp, with the highest ridges standing as much as 2,500 feet above Kane Springs Wash. The eastern portion of the range is a dip slope that drops off more gradually. The major thrusts and normal faults in the area are pre-Miocene and are overlain by volcanic rocks. Folding related to the thrusting occurs in the east half of the range.

The topography is rugged and the average elevation of the range is approximately 4,000 feet. The western half of the range drains into Kane Springs Wash and Coyote Spring Valley

and the eastern half discharges into Meadow Valley Wash, all of which drain into the Colorado River.

2. ROCK UNITS

The oldest rocks in the study area are the alternating limestone and dolomite units of the Cambrian Highland Peak Formation. Deposited next were undifferentiated Cambrian limestone and dolomite units and the Dunderberg Shale.

The Ordovician Pogonip Group, composed of alternating grayish to brownish, thick-bedded, cliff-forming limestone and yellowish to brownish, gray, slope-forming silty and shaly limestone, was conformably deposited next. A small outcropping of Ordovician Eureka Quartzite, the next youngest formation is located in the west-central portion of the range. Small outcroppings of the Ordovician Ely Springs Dolomite are also found along the western range front.

The Silurian Laketown Dolomite, which generally forms a bold three-part crop out was next deposited.

The next oldest Paleozoic formation deposited is the lower Devonian Sevy Dolomite which unconformably overlies the Laketown Dolomite. The Sevy Dolomite is a remarkably homogenous, generally unfossiliferous microcrystalline dolomite that weathers to a characteristic whitish gray. The Simonson Dolomite was deposited next, and can be distinguished from the homogenous Sevy Dolomite by its alternating sequence of dark and light Dolomite of several types. Deposited next was the Guilmette Formation which has a yellowish 50 to 70-foot thick basal silty Dolomite which is overlain by several hundred feet of cliff-forming limestone beds.

Thin strips of the Late Devonian-Early Mississippian Pilot Shale, which forms a conspicuous, partly covered weak zone under the overlying Mississippian limestone cliffs, occur in the southern half of the range. The Mississippian limestones include the cliff forming Joana Limestone and the overlying Cherty Monte Cristo Limestone.

Undivided Mississippian clastic rocks, including the Chainman Shale and the Scotty Wash Quartzite, were deposited unconformably over the Mississippian limestone.

Undivided sequences of Permian and Pennsylvanian limestone and sandstone were deposited next. A large block of these units crop out along the eastern range front of the Meadow Valley Mountains.

The next oldest formations are the Cherty Monte Cristo Limestone, the undivided Kaibab Limestone and Toroweap Formation and the Permian Red Beds. The red beds are composed of siltstones, sandstones and gypsum. The Toroweap and Kaibab

form a conspicuous double limestone cliff that is separated by nonresistent beds.

An erosional unconformity separates the Triassic Moenkopi Formation from the Permian limestones. The widely distributed Moenkopi Formation consists of limestone and red beds. The Chinle Formation was deposited next after a period of erosion, and is composed chiefly of fine-grained silty sandstone, siltstone and shale that are predominantly reddish.

The Paleozoic and Mesozoic sediments are overlain by Tertiary volcanics which are predominantly an ignimbrite series that consists of welded vitric and crystal tuffs, pumice, flows, domes and perlitic rocks. This sequence ranges in age from Oligocene to Pliocene with the composition ranging from rhyolite to basalt. These volcanics are part of a belt of largely siliceous volcanic rocks 17 to six million years old extending east-west across Nevada at this latitude which erupted from several caldera complexes (Stewart, 1980). Noble (1968) describes one of these calderas, the Kane Springs Wash caldera centered to the immediate west of the Meadow Valley Mountains, centered in the Delamar Mountains. A Pliocene basalt unit locally caps the older Tertiary volcanics. Outcrops of this basalt are found in the northern portion of the study area.

Lake beds of the Muddy Creek Formation were deposited during the late Pliocene over a large area in southeastern Lincoln County. These rocks are largely siltstone and clay shale, which crop out along Meadow Valley Wash and in the southern part of the GRA.

Older gravels covering much of the valley floors on both sides of the range were unconformably deposited probably during the early quaternary.

3. STRUCTURAL GEOLOGY AND TECTONICS

The rocks in the Meadow Valley Mountains GRA are broken by many thrust(?) and normal faults. The major structures are pre-Miocene and are overlain by the volcanic rocks. The post-volcanic faults include some which are probably related to the Kane Springs Wash caldera to the immediate west. Basin and Range faulting, responsible for much of the present day topography occurred during the Miocene and early Pliocene and is responsible for the large. The northeast-trending Kane Springs Wash fault which forms the western escarpment of the northern part of the range. Most faults in the GRA dip steeply or are vertical, and trend northeastward subparallel to the major fault responsible for Kane Springs Wash. Several cross faults transect the range.

Although low angle thrust faults were not certainly identified, Tschanz and Pampeyan (1970) suggest that post-Chinle thrusting has probably played an important part in the structural history of this area. In the central portion of the study area the east half of the range has been strongly folded and the eastern edge of this block may represent the leading edge of an incipient thrust plate.

West of Vigo, the less competent Permian red beds form tight folds, many of which are recumbent in the upper gypsiferous portion. This folding apparently reflects tectonic movements in pre-Laramide time and is related to the major angular unconformity at the base of the Moenkopi Formation.

4. PALEONTOLOGY

The Meadow Valley GRA contains fossils of Early Ordovician age in T 10 S, R 64 E, from outcrops of limestone units assigned to the Pogonip group (U.S. 7 S. locality D 552-CO, Tschanz and Pampeyan, 1970). The fauna consists of (?)Maclurites Sp., unidentified gastropods, nautiloids, and large species of Receptaculites.

The Cambrian Denderberg Shale contains a varied fauna at several areas of outcrop (Palmer, 1960), however, no specific localities are noted from Meadow Valley Mountains GRA.

Outcrops of the Simonson Dolomite (or equivalent) commonly contain bioherms of stromatoporoids and poorly perserved dolomitized favositid corals, in particular Cladopora and Thamnopora, and occassional brachiopods (Productella, Atrypa, and Emanuella are most characteristic). Fossiliferous exposures are in T 10 N, T 9 N, of R 65 E

Lacustrine sediments interbedded with Tertiary volcanics throughout much of the area of the GRA are potentially fossiliferous, but no precise localities were noted from the literature search.

Gundry (1983) reports that silicified logs have been found west of Vigo.

5. HISTORICAL GEOLOGY

During the Paleozoic era miogeosynclinal facies rocks were deposited throughout the area. A major erosional unconformity separates the Paleozoic and Mesozoic sediments. Red beds and clastic units were deposited throughout the early Mesozoic, however, these sediments were largely eroded away in most of Lincoln County during the Laramide orogenic period that began with late Triassic uplift and culminated in Cretaceous thrust faulting.

Subsequently, volcanic activity during the Oligocene, Miocene and early Pliocene time resulted in thick ignimbrite sequences including silicic volcanism from nearby caldera complexes. Volcanism was followed by Basin and Range faulting after which the Pliocene lake beds were deposited.

Quaternary gravels, derived from the eroding nearby mountains were deposited in the intermountain valleys.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

There are no known metallic mineral deposits in the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no reported metallic mineral occurrences or prospects known to occur in the GRA. There is a prospect in Sec. 33, T 9 N, R 65 E that was found during field verification of this GRA in early December of 1982. The prospect is on a large group of lode claims staked in 1981 which are purportedly owned by James Bradshaw (see Claim Map). A shallow prospect was found in a steeply-dipping, narrow, black carbonaceous shale unit which is a part of the Paleozoic sequence exposed at the west base of the range. The area staked covers both the Paleozoic sequence, consisting principally of carbonate units, and parts of the overlying volcanic rocks. It is believed the claimant staked the claims for disseminated precious metals associated with the black carbonaceous shale. Both a ground reconnaissance and aerial photo evaluation showed no obvious presence of alteration with associated mineralization.

During our field verification a small mill was seen in Meadow Valley Wash near Rox. It appeared to have been recently active but it is unknown where the ore, a whitish clayey material, is coming from.

3. Mining Claims

Claims in the WSA which are believed to be for metallics include those described above under known prospects.

There are no other known metallic mineral claims in the WSA. There is a large block of association placer claims in the southeastern part of the GRA, a few of which are inside the WSA, which are staked for an unknown commodity. They are a part of a large block of claims recently staked on the alluvium to the east and south. The local rumor is that these claims were staked for precious metals.

In addition there is one claim, called the Lake Valley Silver, on the west side of Kane Springs Wash in T 9 S, R 65 E in volcanic rocks, but this is outside the WSA.

4. Mineral Deposit Types

If the claims in the WSA are indeed for precious metals, they are of two types. The claims in the southeast area are for placer gold, while the claims along the west side of the range may be for disseminated gold in the carbonaceous shales or possibly the volcanics which may be related to the nearby caldera.

5. Mineral Economics

From the inferred geologic environment it seems unlikely that economic deposits of gold in place could be found on the placer claims covering a large area in the southeastern portion of the GRA. And if gold is associated with the carbonaceous shales on the west flank of the range, the economics could only be ascertained after a more detailed evaluation of the purported disseminated mineralization.

The major use of gold is for storing wealth. It is no longer used for coinage because of monetary problems, but many gold "coins" are struck each year for sale simply as known quantities of gold that the buyer can keep or dispose of relatively easily. The greatest other use of gold is in jewelry, another form of stored wealth. In recent years industrial applications have become increasingly important, especially as a conductor in electronic instrumentation. In the United States and some other countries gold is measured in troy ounces that weigh 31.1 grams -- twelve of which make one troy pound. Annual world production is about 40 million ounces per year, of which the United States produces somewhat more than one million ounces, less than one-fourth of its consumption, while the Republic of South Africa is by far the largest producer at more than 20 million ounces per year. World production is expected to increase through the 1980s. For many years the price was fixed by the United States at $35 per ounce, but after deregulation the price rose to a high of more than $800 per ounce and then dropped to the neighborhood of $400 per ounce. At the end of 1982 the price was $460.50 per ounce.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

Cochran (1951) describes a perlite deposit, the Johnson & Fitchett, in Sections 27, 28, 29, 33, 34 and 35 of T 8 S, R 66 E in the northern part of the WSA (see Nonmetallic Minerals Land Classification and Occurrence Map). There are lenticular inclusions of perlite four to 50 feet thick between flows which dip as much as 80 degrees. Cochran

estimates there are at least 1,000,000 tons of reserves, but in individual deposits containing only a few thousand tons of mineable perlite. No production has been reported from this deposit, and it was not visited during the field verification.

There is a gypsum deposit named the Robb just west of the railroad siding at Galt on the west side of Meadow Valley Wash and within the WSA. Its exact location is not certain but this is supposedly the deposit which Tschanz and Pampeyan (1970) refer to as being one of the best deposits in Lincoln County. It is located in the Permian red beds, and is about 2,600 feet long and 1,000 feet wide with individual gypsum beds dipping steeply and ranging in thickness from inches to 20 feet. Jones and Stone (1920) believe that because of the variable thickness and the steepness of the beds, that only approximately 15% of the deposit is mineable. This deposit was not visited during the field investigation because of difficult accessibility and time limitations.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Other occurrence of nonmetallic minerals in the GRA include several borrow pits in the alluvium in the southern part of the GRA along the roads but there are no borrow pits known to be in the WSA. It is reported, however, that some material sites were utilized as a source of rip-rap for the Union Pacific Railraod in Meadow Valley Wash but their locations are unknown (Gundry, 1983).

There are two placer claims in approximately Section 34 of T 9 S, R 65 E which Gundry (1983) indicates involve "wonderstone" where ornamental rock is quarried which displays when properly broken parallel or concentric rhythmic bands.

Three prospects are shown in the southeastern part of the WSA on the Farrier 7.5 minute quadrangle map near the Lincoln County-Clark County boundary. These are inside the WSA but the reason for their presence is unknown. This area was visited during the field verification. Many shallow pits are found throughout the area and appear to be for what was once required as location work only. Claims appear to have covered many square miles in the area at one time but they are now apparently abandoned. All the old claims are in old dissected alluvium with the nearest bedrock to the west consisting of Paleozoic limestones.

3. Mining Claims, Leases and Material Sites

The only claims in the GRA that are known to be located for nonmetallic minerals is the group in the northern part of the GRA, outside the WSA, on the northwest side of Kane Springs Wash in T 8 S, R 66 E which is located for perlite and the two placer claims on "Wonderstone" described above. There are no current mining claims on the large perlite deposit previously described in the WSA. Material sites are discussed above under occurrences (2).

4. Mineral Deposit Types

The perlite is part of a volcanic flow and the gypsum is a sedimentary evaporite deposit. The alluvial borrow materials are the products of recent erosion of the bedrock units. Not enough is known about the "Wonderstone" quarries but they appear to be part of the volcanic sequence.

5. Mineral Economics

The perlite deposit evidently has substantial reserves. The economics of developing a perlite deposit are influenced by the physical characteristics of the perlite, the reserves available, transportation considerations, but most importantly finding a market for the material. The gypsum deposit may be economically feasible to work, but here again, the most important consideration in developing a deposit such as this is finding the market.

Perlite is a glassy volcanic rock that has the unusual property of expanding to about 20 times its original volume when heated to the proper temperature. Almost all of it is used in the expanded form. The largest use of perlite, accounting for more than half of United States consumption, is in construction where it is used as a lightweight and insulating aggregate in concrete, alone as an insulator, as an aggregate in fireproof plastic mixes for structural steel, and in other applications. About 15 percent of usage is as a filter aid in many food and beverage applications. Less than 10 percent is used in agriculture as a soil conditioner, and a great variety of other applications consumes the remainder. The United States uses about 600,000 short tons annually and produces this much plus a little more that is exported. Consumption is forecast to about double by the year 2000, with production keeping up with demand. The price of crude perlite is about $25 per short ton.

By far the greatest use of gypsum is in prefabricated products, mostly wallboard, which account for nearly three-fourths of all usage. Most of the remainder is used

in cement, as an agricultural soil conditioner, and in plaster. The United States consumes about 20 million tons of gypsum annually, about two-thirds of it produced domestically. Gypsum is a relatively common mineral and occurs in large deposits, and the United States has practically unlimited reserves. However, although its commonness makes it a low-priced material, some plants on the eastern seaboard use imported raw material that can be transported by ship at low cost, and this accounts for the imports of gypsum. United States consumption is forecast to nearly double by the year 2000, with domestic production keeping up with demand except in those special situations where imported material can compete. The price for gypsum is about $7 per short ton.

Pure limestone and dolomite are used principally to produce lime, but some is used as rock for building stone, crushed rock, and similar applications. The principal uses of lime are in steel smelting, water purification, as an alkali, in paper and pulp manufacture, and sewage treatment. Other uses for lime are in sugar purification, mortar, and as an agricultural soil conditioner. Limestone with certain clay impurities (called cement rock), or purer limestone with clay added, is used to make cement that is mostly consumed in construction. The United States uses about 20 million tons of lime and 85 million tons of cement annually. For both lime and cement the raw material must be mined within a very few miles of the processing plant, because it has a very low value in the form of run-of-mine rock -- two or three dollars per ton. There are numerous lime and cement plants in the United States, and most of them sell most of their product within a 200-mile radius of the plant. Some cement is imported in the form of clinker, which is the kiln-fired rock that is then ground in the United States. In the early 1970s the price F.O.B. plant of both lime and cement is about $40 per ton.

The most common use of sand and gravel is as "aggregate" -- as part of a mixture with cement to form concrete. The second largest use is as road base, or fill. About 97 per cent of all sand and gravel used in the United States is in these applications in the construction industry. The remaining three percent is used for glassmaking, foundry sands, abrasives, filters and similar applications. The United States uses nearly one billion tons of sand and gravel annually, all of it produced domestically except for a very small tonnage of sand that is imported for highly specialized uses. Since construction is by far the greatest user of sand and gravel, the largest production is near sites of intensive construction, usually metropolitan areas. Since sand and gravel are extremely common nearly everywhere, the price is generally very low and mines are very close to the point of consumption -- within a few miles as a rule. However, for some

applications such as high-quality concrete there are quite high specifications for sand and gravel, and acceptable material must be hauled twenty miles and more. Demand for sand and gravel fluctuates with activity in the construction industry, and is relatively low during the recession of the early 1980s. Demand is expected to increase by about one third by the year 2000. In the early 1980s the price of sand and gravel F.O.B. plant averaged about $2.50 per ton but varied widely depending upon quality and to some extent upon location.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits within or near the WSA or the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There is one uranium occurrence just outside the southwestern border of the WSA though within the GRA (see Uranium Land Classification and Mineral Occurrence Map at back of the report). This is the Fry and Jeffers claim, Sec. 6 or 7, T 13 S, R 64 E. Radioactivity occurs in a black Paleozoic limestone at this site (Garside, 1973). Uranium occurrences have also been noted in the Chainman Shale in the Caliente Resource Area (Gundry, 1983). These occurrences are probably primary accumulations in black, carbonaceous shale.

3. Mining Claims

There are no known current uranium or thorium claims or leases in the GRA.

4. Mineral Deposit Types

The lack of known radioactive mineral occurrences within and near the GRA prevents a discussion of deposit types.

5. Mineral Economics

Uranium and thorium economics cannot be ascertained for the GRA due to the lack of known occurrences. Uranium and thorium appear to be of little economic value in the area.

Uranium in its enriched form is used primarily as fuel for nuclear reactors, with lesser amounts being used in the manufacture of atomic weapons and materials which are used for medical radiation treatments. Annual western world production of uranium concentrates totaled approximately 57,000 tons in 1981, and the United States was responsible for about 30 percent of this total, making the United States the largest single producer of uranium (American Bureau of Metal Statistics, 1982). The United States ranks second behind Australia in uranium resources based on a production cost of $25/pound or less. United States uranium demand is growing at a much slower rate than was forecast in the late 1970s, because the number of new reactors scheduled for construction has declined sharply since the accident at the Three Mile Island Nuclear Plant in March, 1979. Current and future supplies were seen to exceed future demand by a significant margin and spot prices of uranium fell from $40/pound to $25/pound from January, 1980 to January, 1981 (Mining Journal, July 24, 1981). At present the outlook for the United States uranium industry is bleak. Low prices and overproduction in the industry have resulted in the closures of numerous uranium mines and mills and reduced production at properties which have remained in operation. The price of uranium at the end of 1982 was $19.75/pound of concentrate.

Oil and Gas Resources

1. Known Oil and Gas Deposits

There are no known oil and gas deposits in the GRA.

2. Known Prospects, Oil and Gas Occurrences and Petroliferous Areas

There are no known prospects, oil and gas seeps or shows in the GRA or immediate region. Within the GRA and the WSA Texaco Inc. completed the Federal No. 1 (Locality #1 on the Oil and Gas Occurrence and Land Classification Map) at a depth of 7,030 feet in 1972 (Garside and others, 1977). There were no shows of oil or gas reported (Nevada Bureau of Mines and Geology Oil and Gas Files, 1982).

The GRA is situated in the petroliferous, Paleozoic miogeosyncline portion of Nevada and Utah.

3. Oil and Gas Leases

All the GRA has been leased for oil and gas.

4. Oil and Gas Deposit Types

Oil deposits that have been found and developed, and those that are being explored for in the Basin and Range to date, have been limited to the Upper Paleozoic section of the miogeosyncline and the Tertiary section of the intermontane basins. The source rocks are assumed to be in Paleozoic horizons, such as the Mississippian Chainman Shale, and perhaps also Tertiary section.

The reservoirs at the Trap Spring and Eagle Springs oil fields in Railroad Valley are the Oligocene Garret Range volcanics or equivalent, which produce from fracture porosity; or the Eocene Sheep Pass Formation, a freshwater limestone. Minor porduction has been recorded from the Ely(?) Formation of Pennsylvanian age at Eagle Springs. It may be that production also comes from other units in the Tertiary or Paleozoic sections in the Blackburn oil field in Pine Valley or the Currant and Bacon Flat oil fields in Railroad Valley.

The GRA is within or close to the North American Overthrust Belt which has good oil and gas production in Wyoming/Utah, Mexico and Canada (Oil and Gas Jour., May 12, 1980). The Federal leases in Nevada are for rank wildcat acreage, and surficial stratigraphic units do not necessarily have a direct bearing on possible drilling objectives at depth, considering overthrust structural implications.

Recent seismic surveys (e.g., Seisdata Services, 1981; Geophysical Service Inc., 1981; GeoData, 1981: Index maps in GRA File) indicate, in part, the generla area of industry interest. This and certain other data may be purchased, but deep exploratory test data are not readily available. Published maps of the Overthrust Belt in Nevada are very generalized, and are not necessarily in agreement because exploration is at an early stage (Oil and Gas Jour., May 12, 1980; Western Oil Reporter, June, 1980; Keith, 1979: Index maps in GRA File).

5. Oil and Gas Economics

The low level of production from Nevada Basin and Range oil fields, which are remote from existing pipelines, existing refineries and consuming areas, necessitates the trucking of the crude oil to existing refineries in Utah, California and Nevada. Since the discovery of oil in Nevada in 1953, the level of production has fluctuated. Factors which have affected the production from individual wells are: reservoir and oil characteristics; Federal regulations; productivity; environmental constraints; willingness or ability of a refiner to take certain types

of oil; and of course, the price to the producer, which is tied to regional, national and international prices.

Geothermal Resources

1. Known Geothermal Deposits

There are no known geothermal deposits in the GRA or surrounding valleys.

2. Known Prospects, Geothermal Occurrences, and Geothermal Areas

There are no known prospects or occurrences in the GRA, but it is located in a part of the Basin and Range province that has shallow, often high-volume, low-temperature resources.

3. Geothermal Leases

There are no geothermal leases in the GRA or the region around it.

4. Geothermal Deposit Types

Geothermal resources are hot water and/or steam which occurs in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year around mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), extraction of salts by evaporation and crystallization (266°F), and drying of diatomaceous earth (338°F). These are only a few examples.

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

There are no other known unusual or outstanding geological resources in the GRA or the WSA. Coal is not known in the GRA, and there is no known potential for coal.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States during a national emergency and are not found or produced in

the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

There are no known strategic or critical mineral resources in the GRA or the WSA.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES

The geologic maps which cover the entire WSA include Tschanz and Pampeyan's (1970) county geologic map and Howard (1978), both at a scale of 1:250,000, and both essentially the same for the Meadow Valley Mountains. The very southern portion of the WSA is in Clark County and is covered by Longwell, et. al., (1965) also at the same scale. The scale on these maps is too small to show much detail and areas of alteration, if present, are not included. The Kane Springs Wash caldera complex was not recognized on these maps, however, but is shown on both Stewart and Carlson's (1976, 1978) state geologic map and "Cenozoic Rocks of Nevada" map at even smaller scales. There is little data on mineral occurrences in this area except for Tschanz and Pampeyan (1970) and here the data is limited. Overall the quantity of geological data available is limited with more detail needed, but the quality of this information is high. The amount of data relating to mineral resources or their potential is limited but the quality is high.

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, e.g., M1-4D. Uranium and thorium areas have the prefix U. Nonemtallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSAs. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of the surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA NV 050-0156

M1-2B. This classification area is one of low favorability with a low confidence level and covers that ground covered by the large block of lode claims owned by James Bradshaw. The low classification of 2 is based on the presence of the lode claims which can be considered indirect evidence of mineralization, hence the B confidence level. A quick ground reconnaissance at the site did not confirm the presence of mineralization or associated alteration. This area needs further study in order to verify precious metal potential.

M2-1B. This classification area includes all the exposed Paleozoic and Mesozoic sediments throughout the WSA. The classification 1, no evidence indicating favorability, is because there is no information available that points to the possibility of mineralization in these areas. The confidence level of B is because the exposures show no sign of mineralization hence that is indirect evidence. Still the possibility exists that more detailed mapping or sampling could delineate potential mineralization. Similar rocks in other areas of eastern Nevada do contain mineralization.

M3-2A. This classification area of low favorability with a very low confidence level includes all the exposures of Tertiary volcanic rocks. There is no evidence of mineralization in the volcanic rocks, but the nature of the underlying Pre-Tertiary rocks is unknown. Elsewhere, in both Lincoln County to the north and Clark County to the south, pre-Tertiary rocks are mineralized. Since we know nothing about the nature of these underlying rocks the possibility exists that they may be mineralized hence the 2 (low) favorability. However we have no evidence for this low favorability and have given it a very low confidence level of A. In addition there has been some interest in alunite in the Clover Mountains to the northeast in which aluminum is the reported commodity of interest. Alunite is an alteration product of the volcanic rocks (Gundry, 1983).

M4-2A. This classification includes all the area covered by alluvium in the WSA. There is no evidence suggesting the presence of metallic minerals, however, the alluvium masks the underlying bedrock, the mineral potential of which is unknown. The same rationale applies here as in M3-2A above in that the unseen rocks could be mineralized therefore the low favorability, however the confidence level for this classification is very low.

M5-2B. This classification area of low favorability with a low confidence level includes only that part of the alluvium in the WSA which is covered by placer claims. The potential for placer deposits of precious metals is implied because of the presence of the claims but no other direct evidence is available. The presence of a claim does not prove the presence of minerals, hence a more thorough evaluation of this area and the claims is warranted.

b. Uranium and Thorium

WSA NV 050-0156

U1-2B. This land classification covers the western two thirds of the WSA and indicates that uranium has low favorability for concentration in the area at a low confidence level. Paleozoic marine limestones and dolomites, and Oligocene to Pliocene volcanics cover the area, with the Paleozoic sediments predominantly in the southern half of the WSA and the Tertiary volcanics comprising most of the northern section. The acidic stages of these Tertiary volcanics are a potential source of uranium. The uranium could be concentrated along fractures and permeable sections of the volcanics and the Paleozoic limestones.

Uranium may also occur as low grades primary concentrations from seawater in reduced facies in limestones or in black shales, such as the Chainman Shale which is exposed in the southern part of the WSA. The presence of uranium in black limestone (Fry and Jeffers Claim) and the Chainman Shale which is discussed under uranium occurrences, indicates that there may be some potential for this type of deposit in the WSA.

Thorium is not favorable for concentration in the area at a very low confidence level as there are no known suitable thorium source rocks (granites) in or near the area.

U2-2B. This land classification covers eastern sections of the WSA and the area west of the WSA which are covered by Quaternary alluvium and the Tertiary Muddy Creek Formation. The area has low favorability for uranium concentration at a low level of confidence and is not favorable for thorium deposition at a very low level of confidence.

The Tertiary Muddy Creek Formation contains interbedded clays, sands, and tuffs; the tuffs being a possible uranium source rock. The Muddy Creek Formation contains numerous small uranium occurrences elsewhere and is a potential host rock within the WSA. The Quaternary alluvium is also a potential uranium host rock. Sources

for the uranium are the tuffaceous sediments of the Muddy Creek Formation and the Tertiary volcanics of the Meadow Valley Mountains. The uranium could be transported by ground water and deposited in the permeable alluvial sediments, where reducing conditions are encountered.

c. Nonmetallic Minerals

WSA NV 050-0156

N1-4C. This classification of high favorability with a moderate confidence level is the Johnson and Filchett perlite deposit which Cochran (1951) describes and he estimates there are at least 1,000,000 tons of reserves. This deposit was not field verified and there is no other corrobating evidence and no past production therefore a moderate confidence level was assigned. Further verification could raise it to a D.

N2-4C. This classification of high favorability is for the Robb gypsum deposit described by Tschanz and Pampeyan (1970) and Jones and Stones (1920). It is a part of the Permian red beds and reportedly has large reserves. This deposit was not field verified and there has been no past production therefore a moderate confidence level C was assigned.

N3-2B. This classification area of low favorability with low confidence level includes all the remaining volcanic rocks in the WSA. The volcanics have not been subdivided in the northern portion of the WSA. Since a perlite deposit is present in at least one of these units within the WSA, more perlite may be found elsewhere in the area. Also all rocks can be used for at least construction applications and any mineral material can become an economic nonmetallic mineral if a use can be developed for its particular chemical or physical properties.

N4-3C. This classification area of moderate favorability with a moderate confidence level includes all the outcrop area of the Permain red beds in the WSA which are host to the Robb Gypsum deposit. The possibility exists of more gypsum since the Permian red beds throughout southeastern Nevada all contain gypsum, hence the 3C classification.

N5-3C. This classification area of moderate favorability with a moderate confidence level includes all the remaining Paleozoic to Traissic sediments in the WSA, the majority of which are carbonate units. The classification of 3C is because there are probably some carbonate units within this area which could qualify chemically for use in cement or lime manufacture. Also there is a small outcrop area of Upper Mississippian rocks which may include the Chainman Shale. According to BLM records, there has been

some interest in the past in phosphate potential in the Chainman Shale to the north, but nothing else is known concerning this commodity (Gundry, 1983).

N6-3C. This classification of moderate favorability with a moderate confidence level covers all the alluvium within the WSA. This sand and gravel could probably be utilized in various construction applications.

2. LEASABLE RESOURCES

a. Oil and Gas

WSA NV 050-0156

OG1-3A. This classification covers that portion of the WSA that has the Pennsylvanian/Permian miogeosyncline sediments, Tertiary volcanics and valley fill in outcrop. It is assumed that there could be a sufficient prospective stratigraphic section for the generation and entrapment of hydrocarbons. Texaco Inc. Federal No. 1 was drilled within this classification area. There is essentially no pertinent information on this well, and it should not be assumed that an offset test to this well would necessarily be dry also.

There is a question as to whether this WSA is within the prospective Overthrust Belt, but the density of leasing indicates industry's interest in the area regardless.

OG2-2A. The rock units in this portion of the WSA are Cambrian to Mississippian in age at or just below the surface. Since these rocks are older, and appear to be less prospective for the accumulation of hydrocarbons than Upper Paleozoic rocks, the favorability is less.

This WSA is very close to or within the Overthrust Belt, and the lands are wholly leased, which is also indicitive of industry's judgement of the favorability.

b. Geothermal

WSA 050-0156

G1-2A. There are numerous known and probable very large, deep-seated, normal faults throughout the WSA. These faults are the type which often act as conduits for rising thermal waters. The paucity of drilling of any kind in the WSA area may be the reason why no low-temperature resources have been encountered.

c. Sodium and Potassium

WSA 050-0156

S1-1D. This classification applies to the entire WSA. There is no indication of favorability for the accumulation of resources of sodium and potassium.

3. SALEABLE RESOURCES

The saleable resources, sand and gravel, have been discussed above under nonmetallics and include area N6-3C.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

1. Since most of the WSA is remote and has not been mapped in detail only small-scale geologic maps are available. A much more detailed mapping program should be undertaken to more adequately define mineral resource potential. More detailed mapping would especially be beneficial in the areas where volcanic rocks are located and may delineate more perlite, for instance.

2. The known perlite deposit, the Johnson and Fitchett, and the Robb gypsum deposit should be field verified and mapped in detail to assess their mineral resource reserves and their economic potential.

3. The lode claims of James Bradshaw on the western side of the range and the placer claims in the southeastern portion of the WSA should be more thoroughly investigated to assess their mineral potential.

4. The ore being processed at the small mill near Rox may be coming from somewhere nearby and should be further investigated.

VI. REFERENCES AND SELECTED BIBLIOGRAPHY

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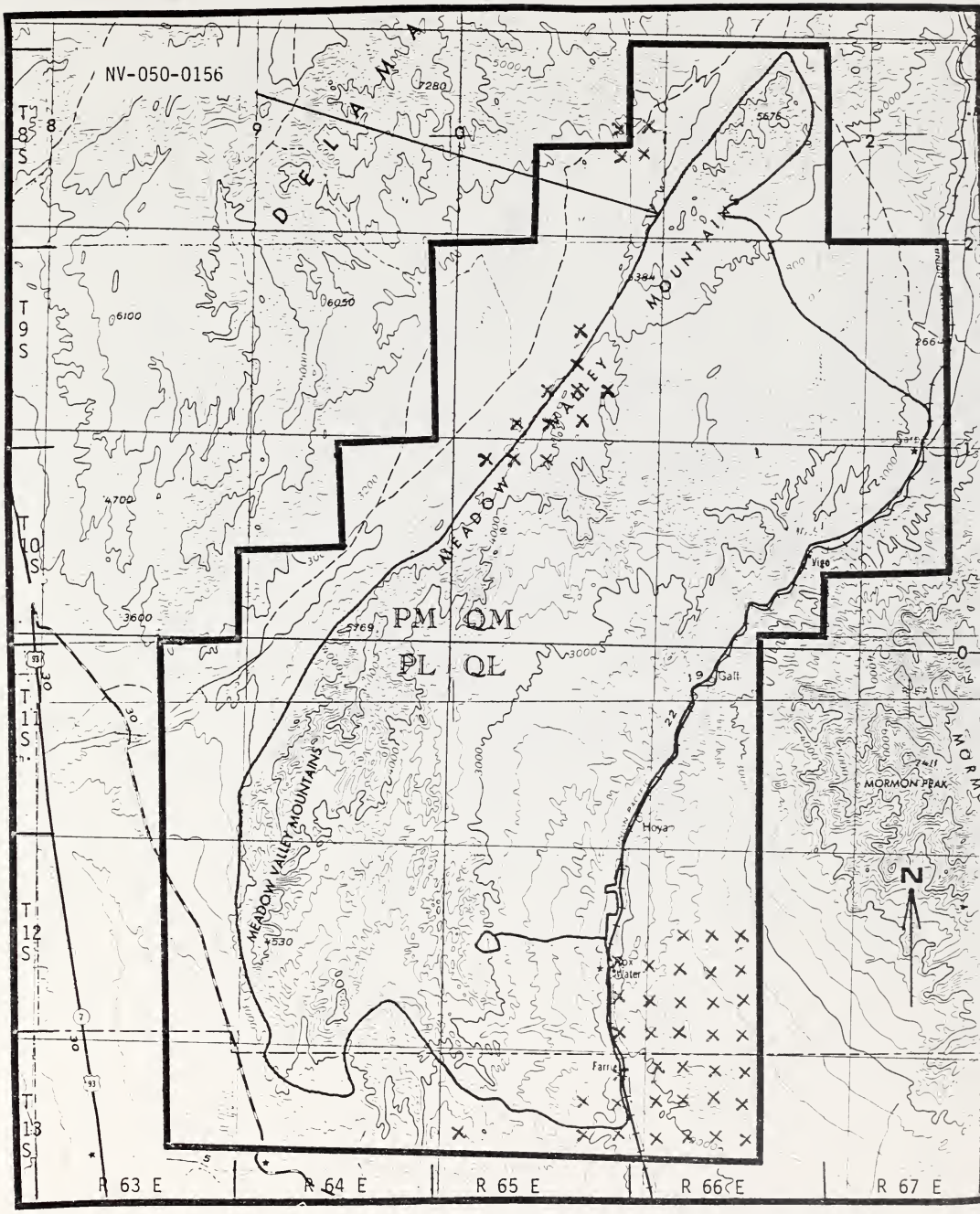
*X denote one or more claims per section



Claim Map
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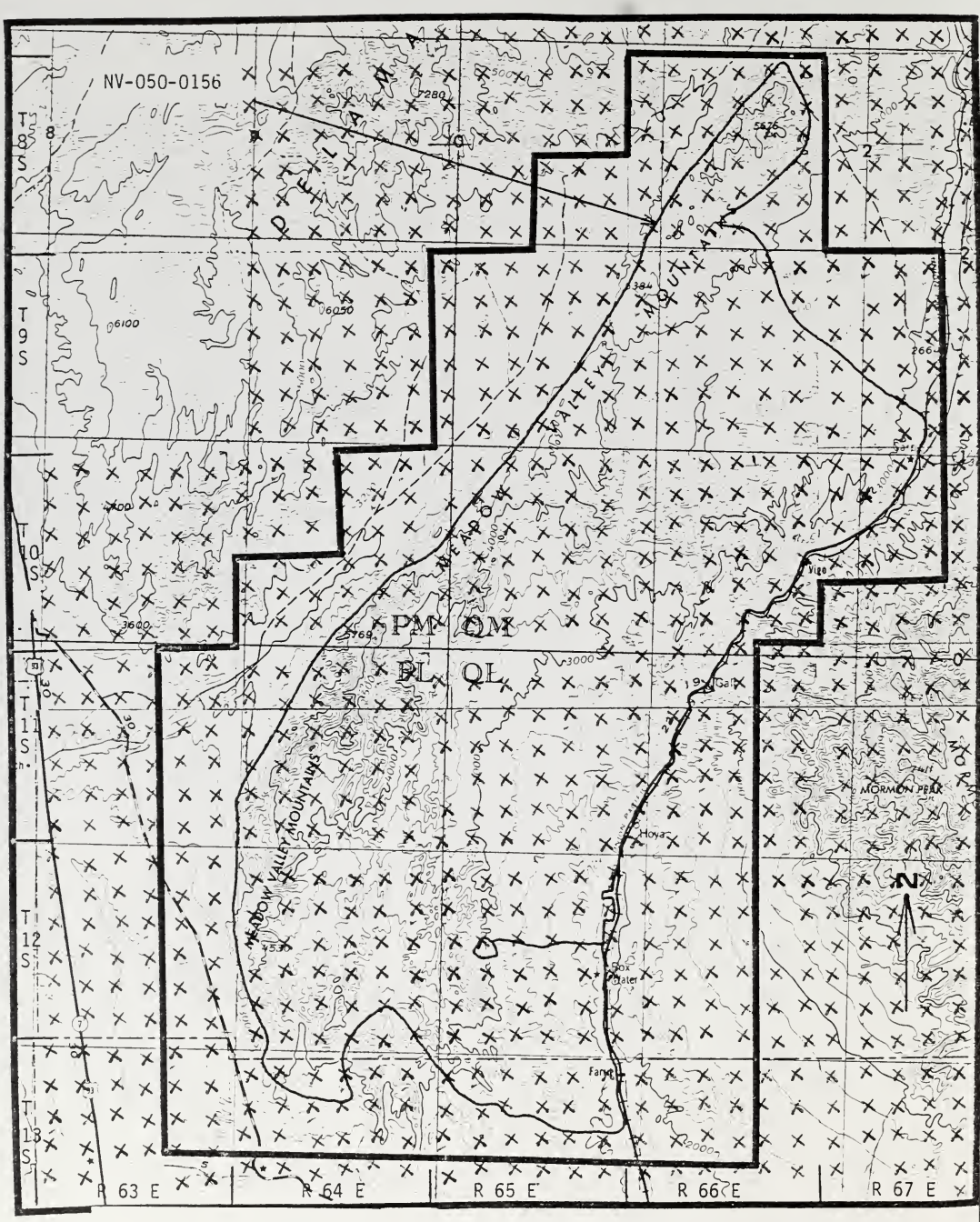
Meadow Valley Mountains GRA NV-26



Meadow Valley Mountains GRA NV-26

Oil and Gas Lease Map
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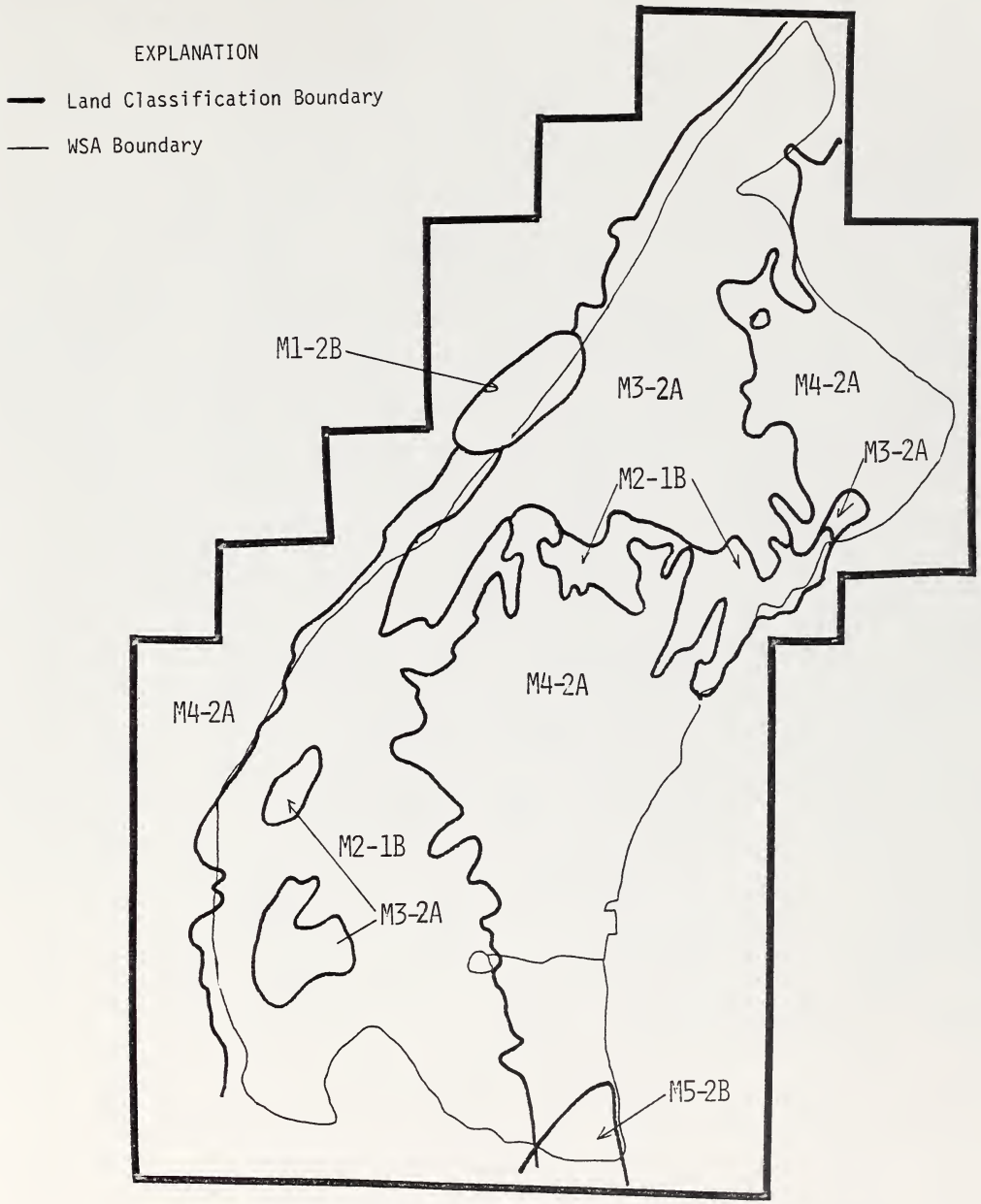
X Leased Section



Land Classification and Mineral Occurrence Map/Metallics
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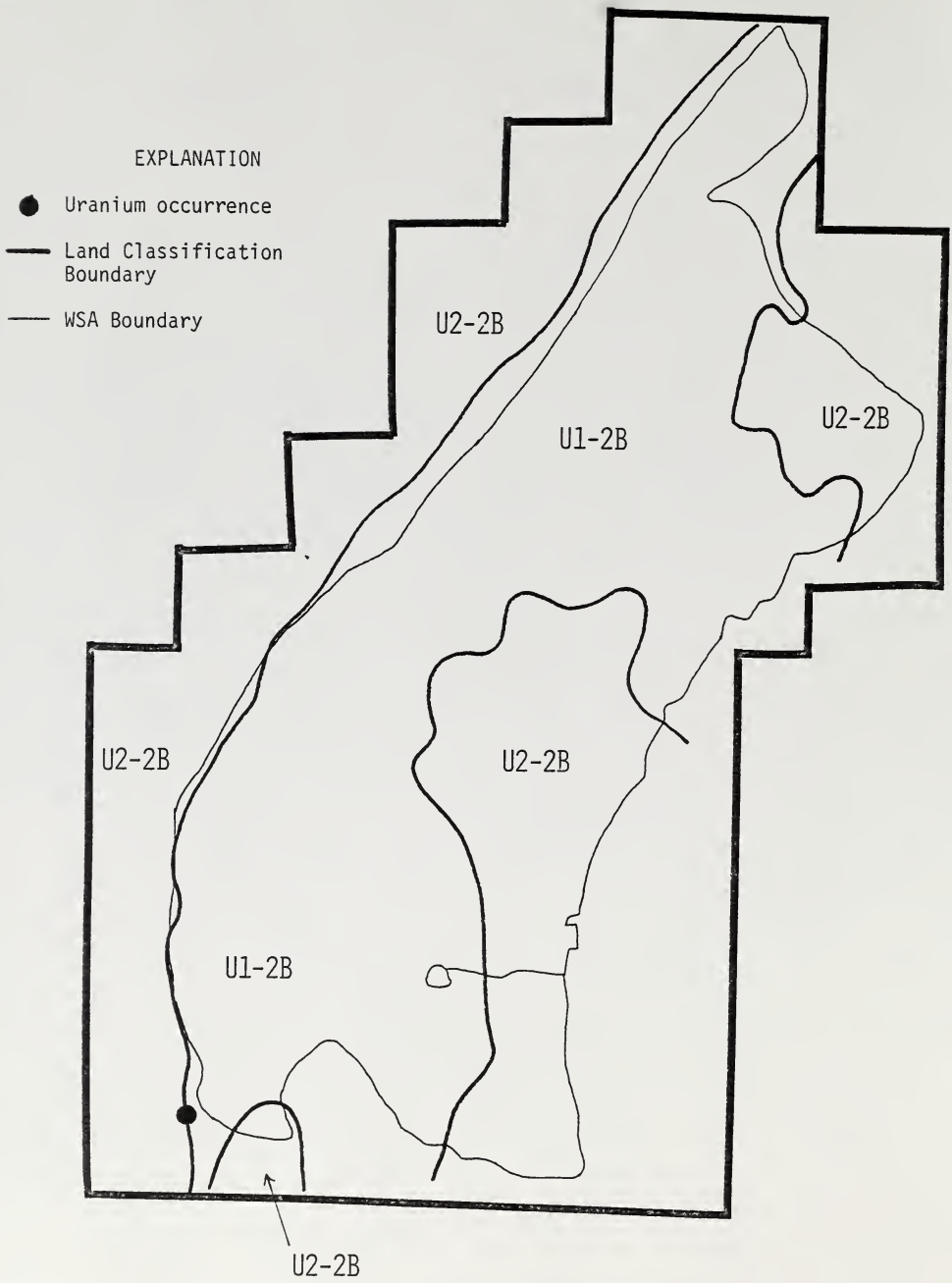

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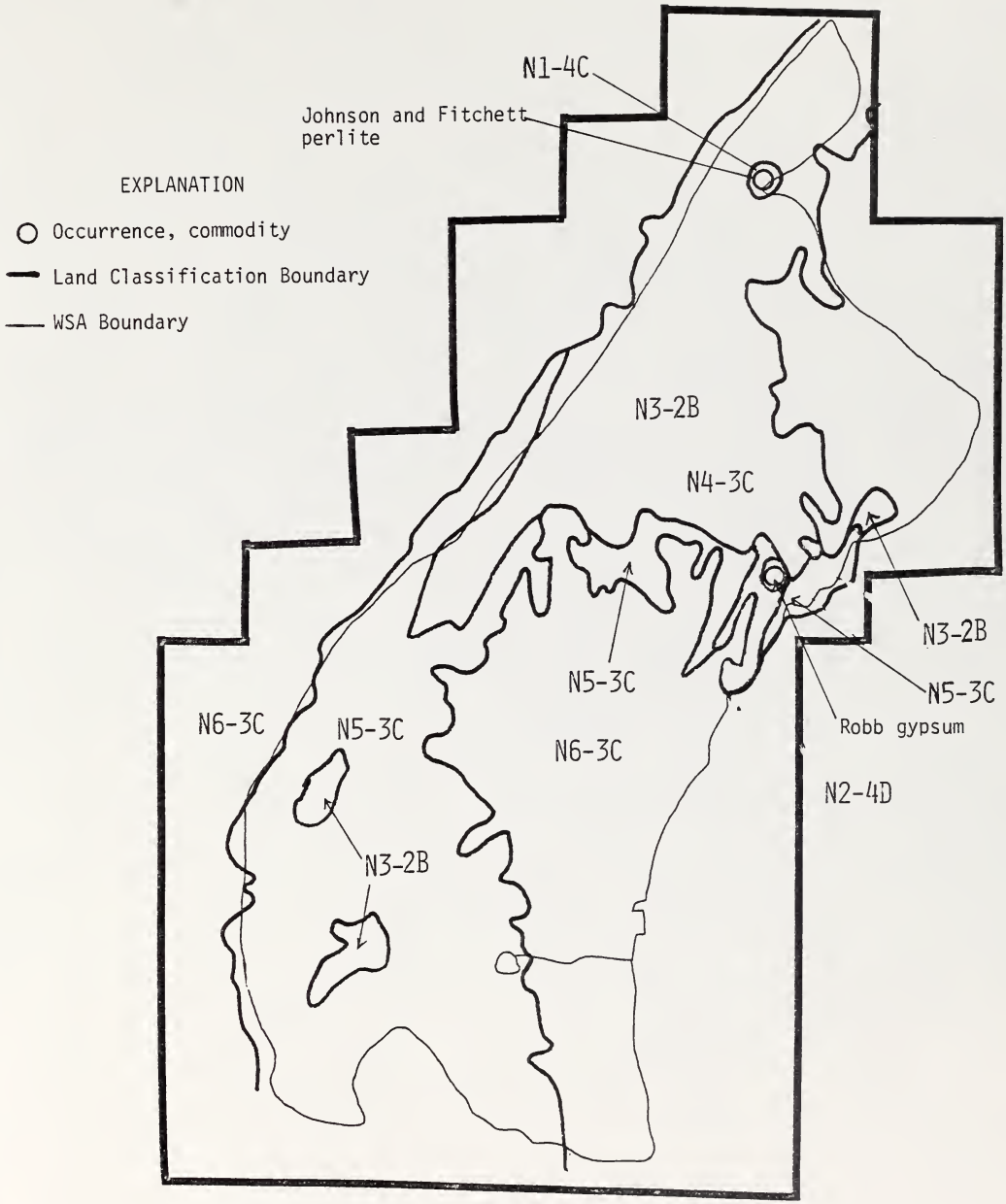

Land Classification and Mineral Occurrence Map/Nonmetallics
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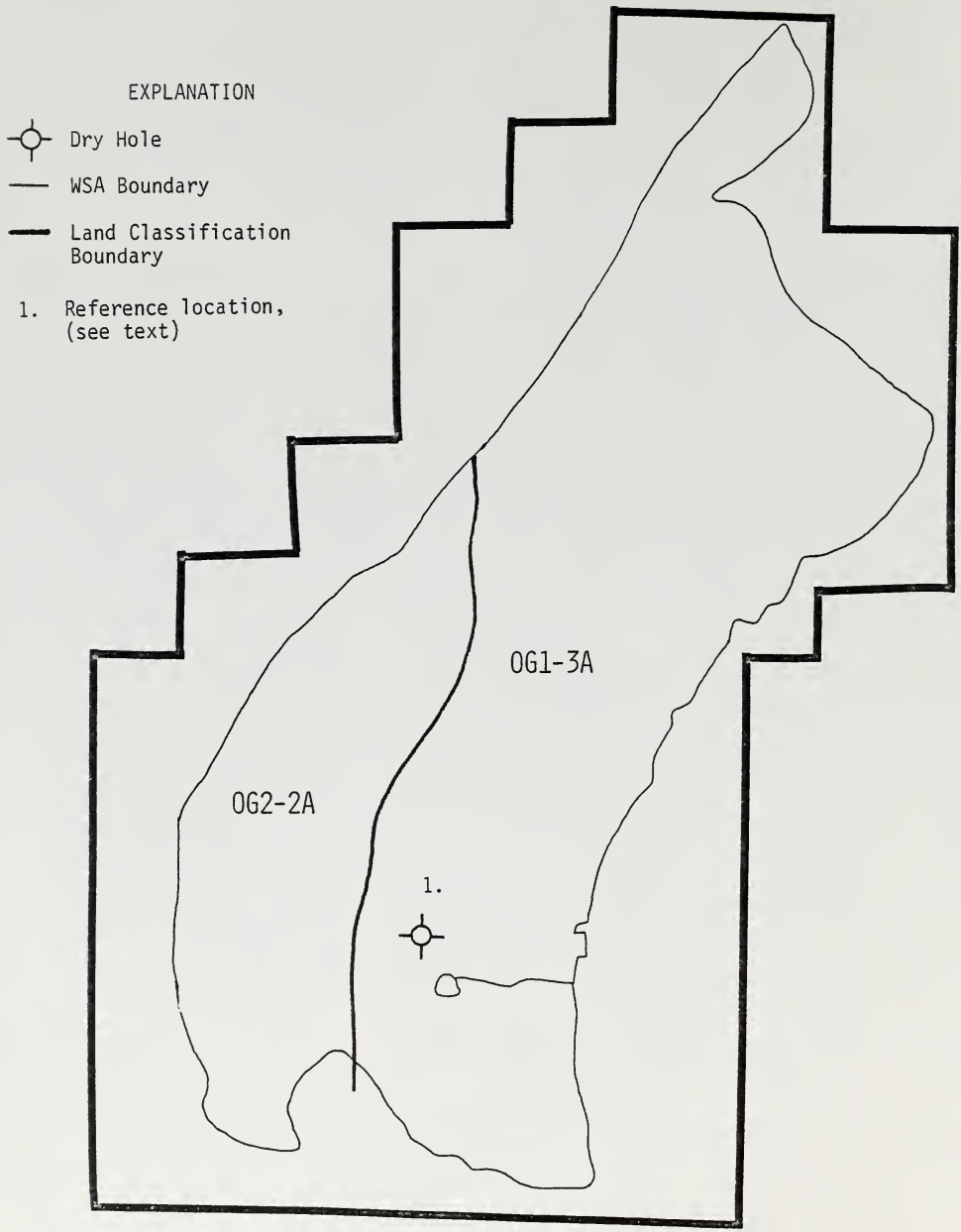

Land Classification - Mineral Occurrence Map/Oil and Gas

Meadow Valley Mountains GRA NV-26

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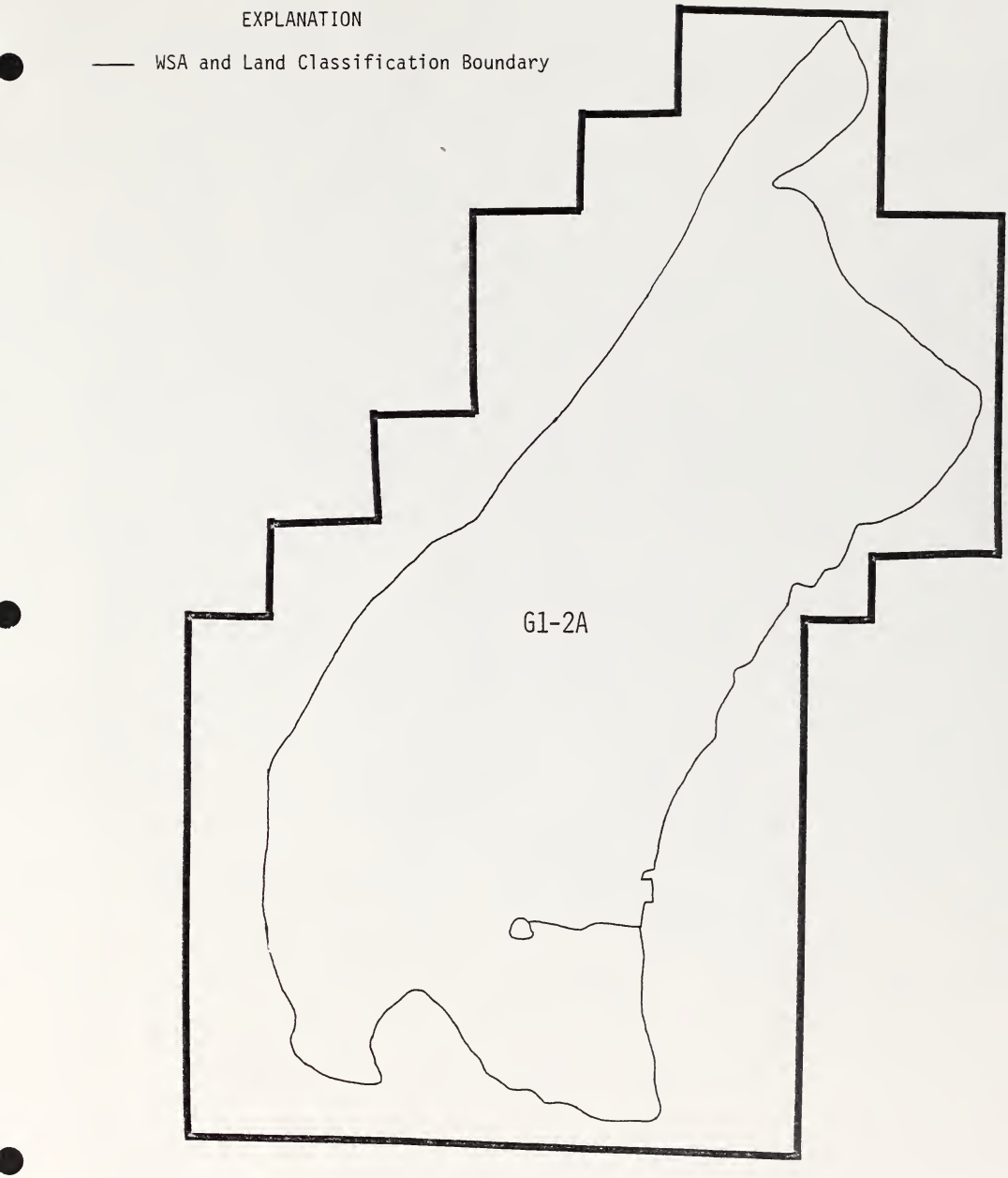

Land Classification - Mineral Occurrence Map/Geothermal

Meadow Valley Mountains GRA NV-26
Scale 1:250,000

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3 [1]
	Tertiary	Pliocene	12 [1]
		Miocene	26 [2]
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous [4]	Upper (Late) Lower (Early)	136
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian [4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems: Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian [4]	Upper (Late) Lower (Early)	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian [4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician [4]	Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian [4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [3]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600+ [3]

[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene; and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

[2] Geological Society of London, 1964, The Phanerozoic timescale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, suppl., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1966, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970